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ABSTRACT

This report examines how the making of inferences plays a role in the comprehension of narratives. The report poses and discusses seven questions: What are inferences? What functions do they perform? What is required to make inferences? What processes are involved? What kinds of inferences are there? How can readers' inferences be assessed? Can comprehension be promoted through asking inferential questions? (FL)

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ON THE MAKING OF INFERENCES DURING READING AND THEIR ASSESSMENT

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On the Making of Inferences During Reading and Their Assessment

In this paper, how the making of inferences plays a role in the comprehension of narratives is indicated. In so doing, seven questions are posed, and answers to each question are discussed. First, what is meant by an inference? Then, what functions are performed by inferences? This is followed by a consideration of what is required to make inferences and what processes are involved in making inferences. Next, the questions, what kinds of inferences are there, what is the relationship between the kinds of inferences, and how can one assess a child's ability to make inferences, are posed. Finally, the practical and educational question of whether one can promote comprehension through the asking of inferential questions during reading concludes the essay.

What are Inferences?

What does a reader do when he/she makes an inference? He/she does one of two things: he/she either finds semantic and/or logical relations between propositions or events which are expressed in the narrative, or he/she fills in missing information which is necessary to making such connections between events. The first kind of inferencing has been called "text connecting" and the second "slot-filling" (Warren, Nicholas, & Trabasso, 1979). These descriptive terms for making inferences come from a recent theory of natural language understanding and memory (Schank, 1975). According to this view, the process of understanding is largely one of translating a series of sentences into a causal chain of underlying conceptualizations. Each sentence consists of one or more conceptualizations

which must be derived from the surface structure expressed in the text. This process involves linguistic and world knowledge about individual word meanings and relations within a sentence. The process of creating the causal chain, however, involves inference generation: The reader is assumed to read a story to generate the causal chain and the memory representation, and to encode events that are explicit along with those that are inferred. This representation in memory is then used to perform a variety of operations such as retelling or recalling the story, summarizing the story, detecting the main ideas, deciding which events occurred in which temporal order, answering probe questions as to causes, consequences, or facts, paraphrasing events, and giving different points of view of the narrative.

All of the above activities may be recognized as either related to comprehension or susceptible to being captured in comprehension tasks (cf. Pearson & Johnson, 1978). The important contribution of Schank (1975) is the stress on the initial understanding by the reader and on the question of what representation of the story is constructed as a result of this understanding at the time of reading. If the reader (or listener) should fail to construct the relations between events, explicit or inferred, then the subsequent activities would not be possible, the reader having no memorial basis for performing them. Representation results from and requires an initial understanding of sentences and their relations and, in turn, precedes all other forms of comprehension.

The assumption here is that the representation or understanding of a story is essentially a chronology of alternating events and states with

causal links. This idea is hardly novel. In fact, Dewey (1933/1963) seemed to have had a similar notion in mind when he wrote on "meaning":

> To grasp the meaning of a thing, an event or a situation is to see it in its relations to other things; to note how it operates or functions, what consequences follow from it; what causes it, what uses it can be put to. (p. 135)

Note, in the above quote, the emphasis on relations to other things, notably causes and consequences.

Since the making of inferences is a highly automatic and largely unconscious process, it is necessary at the outset to use illustrations both to demonstrate what is meant by an inference and to make it clear that the making of an inference, while highly automatic, is not a simple or obvious process. This should become clearer when we try to understand what the process is and how it is made to operate.

Consider the following pair of sentences, taken from Bransford and McCarrell (1975):

(1) John missed the bus.

(2) He knew he would have to walk to school.

Note first that there is no explicit causal connection between (1) and (2). Therefore, the reader, when confronted with this pair of sentences, would have to make assumptions about the connections between (1) and (2) in order to understand them. If these sentences occurred in the order (1) then (2), the reader might infer that (1) was the causal antecedent of (2) and provide the connective "so," "and then," "thus," "as a result," etc. The fact

that we automatically assume (1) to be the cause of (2) becomes more apparent when we try to interpret the following sentence:

(3) John missed the bus because he knew he would have to walk to school.

In (3), the cause/consequence relations of (1) and (2) are now reversed. Presumably, John wanted to walk to school and so he may have deliberately missed the bus.

Again, consider two more examples from Bransford and McCarrell:

(4) The mirror broke.

(5) The child grabbed the broom.

We automatically assume that event (4) is the temporal and causal antecedent of event (5), and we fill in the relation as expressed by connectives such as "so" or "therefore." However, our assumptions about cause and effect are apparent when we encounter event (6) which is contrary to the assumed cause/consequence relation.

(6) The mirror broke because the child grabbed the broom.

When connectives or relations are not explicitly flagged by syntactic markers in text, then readers infer them based upon temporal sequence and causal knowledge of the world. When connectives are explicitly stated, they are used to guide assumptions about causes or consequences in order to comprehend what we read. It makes a great deal of difference in events (3) and (6) how we interpret John's or the child's motives and responsibility for actions or consequences.

Nicholas and Trabasso (in press) cite another example which we shall use to illustrate first what inferences are and which ones appear to be

necessary to understanding text. Then, in the next section, we shall use the example to illustrate functions of inferences.

Suppose you heard the line:

(7) Mary had a little lamb.

What do you think of? Nursery rhymes? Mother Goose? Little girls? Fleecy frolicking lambs? Now, read event (7) in conjunction with each of the following events and note how your interpretation shifts.

(8) Its fleece was white as snow.

(9) She spilled gravy and mint jelly on her dress.

(10) The delivery was a difficult one and afterwards the vet needed a drink.

What assumptions appear necessary to understand event pairs (7) and (8), (7) and (9), and (7) and (10)? In event pair (7) and (8), we use our knowledge to infer that Mary is a character from a well-known nursery rhyme--a little girl who is followed about by her pet lamb. The verb "had" alludes to ownership, and the animal is alive and well.

In (7) and (9), the sheep has not fared so well. Here "Mary" is probably human and female since the pronoun "she" and the noun "dress" allow this inference. "Mary" may also be a child since children are more likely than adults to spill food on themselves. The references to gravy and mint jelly indicate, however, that the lamb is actually a meal, not a pet.

Finally, in (7) and (10), the references to the veterinarian and to a difficult delivery suggest that Mary had given birth to a small lamb and is, herself, a mature, female sheep. The vet is probably an adult, human being whose profession is to tend to sick animals. The drink is likely to

be alcoholic and is presumably taken to enable the vet to relax after the difficult delivery of the newborn lamb.

Note the vast range of assumptions and knowledge that are necessary to understand these pairs of events. We need to know about nursery rhymes, ownership, pets, little girls, sheep, food, animal births, veterinarians, and alcohol. This knowledge is used to construct an interpretation of (7) in the light of (8), (9), or (10). Note, also, that (7) is an inherently ambiguous sentence and that events (8), (9), or (10) invoke knowledge about three radically different contexts in order to infer information that is implicit in the message. The activation of the knowledge contained in (8), (9), or (10) appears necessary in order to interpret (7) in each of its various meanings.

What Functions do Inferences Perform?

Inferences perform a variety of functions, and by indicating this diversity through definitions and examples, we may more fully appreciate their complexity.

First, intended meanings of individual words are often ambiguous and must be arrived at inferentially. Thus, one function of inferences is to resolve lexical ambiguity. In the above "Mary" sentences, for example, the word "had" may be interpreted respectively:

owned or possessed (events 7 and 8)
ate (events 7 and 9)
gave birth to (events 7 and 10),

while, "lamb" may be interpreted, respectively, as:

a living animal (events 7 and 8)
a prepared meal (events 7 and 9)
a newborn sheep (events 7 and 10)

A second function of inferences is to resolve nominal and pronominal references (anaphora). Again, in the above examples:

"Its" refers to the lamb and not Mary in (7) and (8)
"She" refers to Mary and not the lamb in (7) and (9)
"had . . . lamb" refers to delivery or birth in (7) and (10).

In order to interpret sentences while we read, we need to establish a context. This context is also arrived at inferentially. In the above examples, three contexts, or topics, are inferred:

nursery rhyme in (7) and (8)
meal in (7) and (9)
birth in (7) and (10).

A related, fourth function is that inferences aid in establishing a larger framework for interpretation. We shall now present three sentences used by Collins, Brown, and Larkin (in press), to illustrate how we construct and reconstruct "models" (frameworks) from given information. When one is processing the sentences given as data for constructing a framework, the procedure is said to be "bottom-up." Once the model is constructed and is used to interpret new information, the processing is said to be "top-down." The initial step, upon reading sentence (11), is bottom-up, but once the model is established, we use it top-down to guide further interpretation. Some models are inappropriate or cannot accommodate the subsequent events and are, hence, abandoned. New models must be

inferred. So, read and think about your models as you progress through events (11), (12), and (13):

(11) He plunked down $5.00 at the window.

(12) She tried to give him $2.50 but he refused to take it.

(13) So when they got inside, she bought him a large bag of popcorn.

In studying (11), Collins et al. (in press) found that subjects interpreted the window as that at a racetrack and the $5.00 a bet. Probably, the verb, "plunking down," led to this interpretation since this term is jargon used by bettors for the act of making bets. However, this model undergoes reinterpretation in (12), since the attempt to give back $2.50 and its reaction are incongruous with the amounts normally bet at racetracks and with what appears to be the returning of change during a business transaction. Event (13) aids in constructing a new model, namely, going dutch on a date to the movies. The Collins et al. example illustrate what is meant by an interactive model (see Rumelhart (1977) for a discussion of these kinds of models). The central point, though, in the examples is that inductive reasoning is initially involved in constructing the model. Once constructed, the process becomes top-down.

Once a model is constructed, it enables the prediction of a number of events, including probable pre-conditions, causes and consequences of actions, emotional reactions, goals, etc. Those predictions are what guide the assimilation of new information into old and underlie the intense current interest in schemata (Bartlett, 1932), frames (Minsky, 1975), story grammars (Rumelhart, 1975; Mandler & Johnson, 1977; Stein & Glenn, 1979), scripts (Schank & Abelson, 1977), and other organized knowledge bases for comprehension.

In the "Mary" examples above, when one combines events (7) and (9), a pre-condition is that the meal was prepared, an inference is that Mary was hungry and likes lamb, and a prediction is that, since her dress is soiled, her mother may become angry and that she might be punished.

What is Required to Make Inferences?

It is clear that background knowledge is needed to make inferences. What the reader knows or has experienced prior to reading a text is critical, and the reader's knowledge of the world or procedural knowledge may be decomposed into a number of knowledge domains. One implication of this is that, if the children's comprehension of what they read is to be enhanced, then their general knowledge should be increased, as well as the teaching of specific reading skills, after they have learned to decode. In addition, vocabulary (conceptualization) knowledge, regardless of domain, is a crucial pre-condition to comprehension (Pearson & Johnson, 1978; Trabasso, in press), since without understanding the basic concepts contained in the text or question, one cannot make inferential links.

Knowledge of text structure also helps comprehension. In narrative and expository texts, this may aid in a top-down fashion. For example, since stories have well defined episodic structures (Mandler & Johnson, 1977; Stein & Glenn, 1979), the reader may establish expectations of settings, of events which create goals for the protagonist, of plans for achieving goals, of actions, of consequences or goal realizations, and of reactions by the protagonist. These structures also presuppose context and relational, as well as functional, knowledge of the grammatical categories.

Knowledge about social interaction and human intentionality may aid comprehension. Stories entail considerable knowledge about social and personal interaction (Shantz, 1975) as well as about goals, plans, and actions (Schank & Abelson, 1977). In short, they represent a kind of naive psychology based upon a theory of actions and motives behind actions. Children acquire and use these naive theories of human motivation and goals to understand narratives. The problem is to determine what they know at different levels of development and how this knowledge interacts with what they read.

Finally, knowledge of causal relations between events is crucial for making inferences. The reader's ability to generate causes and consequences of events enables the prediction and assimilation of events into a causal chain representation as well as the filling in via inferences of missing information. With repeated exposure to situations, the reader develops stereotyped generalized experiences, called scripts (Schank & Abelson), which allow a well-constructed, known causal chain to predict behavior. Deviations from the script require further inferencing. When scripts are not available, the reader used "plans" to acquire information and construct new scripts. In short, the reader's knowledge base, including his/her cultural background, appears to be the bottom line for comprehension.

What Processes are Involved?

In the above discussion, reference was made to top-down and bottom-up processes interacting in making inferences. When top-down, the construction of a causal chain, inferential prediction, and event integration is preceded by organized knowledge structures. When these are absent, the reader must

use word recognition, word knowledge, and linguistic skills to derive sentence meanings and infer a model or framework.

How these processes are accomplished is a mystery, although some computer models are available, such as those discussed by Schank and Abelson (1977) or Kintsch and van Dijk (1978). These approaches both involve the linking of propositions: In Schank and Abelson's system, the concepts are underlying meanings of arguments in propositions and the links are causal in nature whereas in the Kintsch and van Dijk approach, the linkages are determined by concept overlap or repetition across propositions.

What Kinds of Inferences are There?

In this section, a brief summary of the kinds of inferences detailed in an inference taxonomy by Warren, Nichols, and Trabasso (1979) is given. According to Warren et al., inferences may be divided into those which are informational, those which are spatial or temporal, those which are related to script knowledge, those which depend upon world knowledge in some general sense, and those which are primarily evaluative in nature. The first class of inferences are stressed since they are necessary to the construction of relations between events and the building of a causal chain representation. Informational inferences are thought to be more intrapropositional in nature, and while they are crucial to forming conceptualizations of sentence content, and precede the causal connecting of such conceptualizations, the construction of a causal chain is central here.

Logical inferences can go either in a forward (consequent) or backward (antecedent) manner. For example, if the goal of a protagonist is known,

one can expect or predict certain actions to occur as consequences. On the other hand, knowing the protagonist's actions constrains inferences about the reasons why he/she is doing what he/she does. Warren et al. distinguished among four types of logical relations:

1. Motivational. Goals motivate either other goals or such overt actions as events (goals also motivate cognitions, or thoughts, and emotional reactions motivate goals and cognitions).

2. Psychological causes. Actions which are involuntary, as well as thoughts and feelings, are psychologically caused. Crying, inferring, and becoming angry are examples.

3. Physical causes. Physical or natural events or physical actions cause (mechanically cause) changes in state. Breaking a leg or drinking a glass of water are examples of actions which physically cause a change in state.

4. Enablement. Enablements are those conditions, typically states, which are necessary but not sufficient for a state or an action to occur. Having money enables one to buy things.

This listing of causal links resembles, in part, that of Schank and Abelson (1977). In their system, actions result in (physically cause) states, states enable acts; states or actions initiate (psychologically cause) a mental state, and mental actions (goals, thoughts, cognitions) are the reasons for (motivate) physical actions. In addition, one can have preventative causes where a state disables an action.

The logical relations identified above determine the kind of inferences made. If one focuses on an event and asks a why question about that event,

then the kind of inference required is determined by the nature of the link. This does not mean, however, that the kind of processes invoked differ. The same process of finding events related to other events may occur for all four types. In fact, Omanson, Warren, and Trabasso (1978), using probe tests on children 5 to 8 years in age, failed to find consistent differences among logical causes.

How Can We Assess What Inferences a Reader Makes?

In this section, the question of what inferences readers make during reading is not treated directly. At the moment, there are no adequate methods for answering this question (see Trabasso & Nicholas, in press, for a review on inferences by children), and there is considerable debate about how many inferences are necessary for the construction of a representation of events in a narrative (Warren, Nicholas, & Trabasso, 1979). Therefore, a consideration of the kinds of question that could help in finding out if the reader could make certain inferences is now what needs to be discussed. In this discussion, a recent book by Lehnert (1978) on answering questions is a major source.

In order to illustrate the question types and relate them to the inference types above, read the Farmer and the Donkey story in Table 1.

Insert Table 1 about here.

If the reader generates inferences which result in the construction of a causal chain of events, then his/her ability to answer questions about logical relations either during or after the reading of a narrative should reflect this generative capability. Questions can be posed which assess

the reader's knowledge of causal antecedents or causal consequents (Lehnert, 1978). The question itself contains a conceptualization, and the syntactic form of the question determines which kind of relation is being querried.

Referring to the Farmer and the Donkey story in Table 1, causal antecedent questions on inferences of the types previously described may be asked. Consider, first, the following variants of a physical causal antecedent question:

(14) Why did the dog begin to bark loudly?
(15) What caused the dog to begin to bark loudly?
(16) What happened that resulted in the dog's beginning to bark loudly?
(17) The dog barked loudly because . . . ?

Although why-questions signal a causal antecedent relation, examples (14)-(17) indicate what questions as well as what verbs or connectives can mark their relations. Note also that in each example the same conceptualization (the dog barking loudly) is indicated. The reader then must search his/her memory for that conceptualization (here, the cat scratched the dog) which resulted in the dog being in pain (an inference) and barking.

An example of a psychological antecedent causal question is given in (18):

(18) Why did the barking frighten the donkey?

If an event leads to another event, and if questions about the first event are asked, then the answers call for consequential conceptualizations:

(19) What happened when the farmer gave the cat milk?
(20) What resulted from the farmer giving the cat milk?
(21) What happened after the farmer gave the cat milk?

Examples (19)-(21) show variations on a causal consequence question concerning the goal satisfaction of the cat as a pre-condition for the cat scratching the dog. In general, consequence questions are signalled by "What happens when . . . ?"

It is also possible to pose consequence questions negatively to see if the reader understands events that would not have occurred if certain pre-conditions were not met or if certain antecedent events had not occurred. In the context of a story, these are hypothetical non-events. For example,

(22) What if the farmer hadn't given the cat milk?

(23) What would have happened if the farmer hadn't given the cat milk?

(24) If the farmer hadn't given the cat milk, then what would have happened?

The reader can be directed towards consequences by providing information as in,

(25) What did the cat do after the farmer gave the cat milk?

Question (25) specifically directs the reader to the cat's action.

Motivational questions (what Lehnert refers to as Goal Orientation) may be posed as antecedent or consequent (purpose) questions. For example,

(26) Why did the farmer ask the cat to scratch the dog?

could be answered by an antecedent event,

(27) The dog refused to bark at the donkey.

or by a purpose,

(28) He wanted to get the dog to bark in order to frighten the donkey and make him jump into the barn.

The event described in (27) resulted in or motivated the farmer to ask the cat to scratch the dog since it was a failure in the farmer's initial

attempt at a superordinate goal of getting the donkey into the barn. That led to the farmer's subsequent actions. The event in (28) is the reason for, or purpose of, the farmer's asking the cat to scratch the dog.

Motivation questions may require answers involving more than one subgoal and a major goal. Examples (29), (30), and (31) contain questions on actions which could be answered by two, three, or four goals or motives, respectively.

(29) Why did the farmer ask the cat to scratch the dog?
(two reasons)

(30) Why did the farmer ask the cow for milk?
(three reasons)

(31) Why did the farmer give hay to the cow?
(four reasons)

The fourth logical relation, that of enablement, is usually marked by How or What, and calls for answers involving states or action which satisfy specific pre-conditions necessary for the event in the question to occur. Examples (32)-(34) show some variations:

(32) How was the farmer able to get the cow hay?

(33) What did the farmer need to do in order to get the cow hay?

(34) What did the farmer do in order to get the cow some hay?

Enablements may involve a long string of acts. If so, these become instrumental or procedural questions according to Lehnert. For example, asking someone for directions to a house or how to cook coq-au-vin requires a listing of actions and instruments. In the Farmer and the Donkey story,

this amounts to almost re-telling the story in response to the question:

(35) What did the farmer do in order to get the donkey into the barn?

Questions on logical relations between events either assess or prompt the reader's generation of text-connecting or slot-filling inferences. The questions considered next also assess or promote inferential comprehension but they do so within sentences.

The first set of within-proposition questions contains what Lehnert classified as Concept Completion questions. These questions require that the reader search his/her memory or the text for a missing component. These questions basically interrogate case relations (agents, instruments, etc.), of which some examples are:

(36) Who gave the farmer some milk?

(37) What frightened the donkey?

(38) What did the cat reply when the farmer asked him to scratch the dog?

(39) What did the donkey refuse to do?

(40) Where did the farmer go to get the hay?

(41) When did the cat scratch the dog?

(42) To whom did the farmer give the milk?

Questions (36)-(42) are probe questions. These could also be written as forced-choice, disjunctive questions such as,

(43) Did the farmer give the milk to the dog or to the cat?

or as verification questions requiring a yes/no answer as in,

(44) Did the farmer give the cow milk?

Disjunctive and verification questions are easier since they specify the conceptualization fully and require only a direct match between what is in memory and what is in the question. Furthermore, since they do not require a search among a large set of alternatives, the guessing probability is limited to one over the number of alternatives specified in the disjunction, or one-half in the case of two alternatives, and in the case of verification questions. The disjunctive, verification, and what Lehnert calls "feature specification" (e.g., What color is the dog?) questions are close to what is normally termed "literal comprehension." However, this term is misleading, since even the understanding of sentences and their translation into a conceptualization involve considerable linguistic, semantic, contextual, and intential knowledge. It would be better to call these questions text-constrained and within propositional, given the theoretical framework used here.

Two other kinds of questions which cover several events that are inferential in nature also deserve mention. Both are judgmental in that they involve internal scales, one using social or personal opinion criteria, the other using quantification. For example,

(45) What should the farmer have done to persuade the donkey to get into the barn?

calls for an opinion and for the generation of an alternative goal plan. The question involves an evaluation of what the protagonist did. While morality does not enter into this example, moral judgment questions are similar in form to (45).

The second type of question calls for quantification and entails knowledge of classes and class-inclusion relations or an underlying scale for a state. For example,

(46) How many animals were there in the story?

(47) How badly did the farmer want the donkey to get into the barn?

(48) How did the donkey feel?

Can We Promote Comprehension Through Asking Inferential Questions?

There has been a long history of study on whether asking adjunct questions before, during, or after reading helps reading comprehension (Anderson & Biddle, 1975). The answer seems to be that such questions may help or hinder, and it is not clear as to why it does either. Another question arises as well, namely whether questions promote or assess comprehension? One problem with prior research on this question is that the questions used were generated largely on intuitive and informal grounds and did not follow from a model for language comprehension.

According to the causal-chain model, the reader understands a narrative by (a) forming conceptualizations of sentences and (b) linking conceptualizations by generating inferences which connect them. Once the causal-chain is represented in memory, the reader is said to have understood the narrative, and can now perform additional operations upon this representation by use of various interpretive, summarization, or story grammar rules.

The formation of the underlying conceptualizations appears to be a necessary pre-condition to connecting them. Thus, developmentally, one might expect individual sentence comprehension to precede that of linking sentences

via inferences. This, in fact, appears to be the case. Omanson, Warren, and Trabasso (1978) assessed within-proposition comprehension of stories by 5 and 8 year old children by the use of concept completion questions. Then they asked the same children to make logical inferences via the use of causal antecedent and motivational questions, the inferences involving the linkage of the same propositions which they had probed with concept completion questions. The 5 and 8 year old children were matched on how well they answered the concept completion questions, and then were compared on how well they answered the inference questions. The data showed two things: (a) as the children more accurately retrieved concept completion information, the percentage of correct inferences also increased--a result in line with the assertion that conceptual understanding underlies inference generation; but (b) the older children generated more correct inferences, despite the fact the two age groups were matched with regard to their memory of the propositions upon which the inference was based. Thus, finding relations between conceptualizations increases with age, independent of the ability to form the conceptualization.

Returning to the question of comprehension assessment or promotion, the possible influence of within and between conceptualization questions is now examined. In particular, if the reader is asked concept completion questions (who? whom? what?) after each action in the Farmer and the Donkey story, how well the reader understands individual propositions is assessed. It is possible that such questioning could promote sentence comprehension but not promote linking conceptualizations across sentences. In contrast, inferential questions (why?) which assess the reader's comprehension of

relations between propositions could be asked. It is possible that questions which require the finding of logical relations between events during reading could promote comprehension and memory by establishing more links in the causal chain.

Wimmer (Note 1) has performed a provocative study on these questions, using the Farmer and the Donkey story. Wimmer studied how well 4 and 8 year old children could answer questions while listening to the story, and also how well they could later retell the story. He asked different groups of children why questions and who/whom-questions after each action in the story. (Unfortunately, no control group was run where no questions were asked, so we cannot assess the effect of questions per se).

Apparently, comprehension, as assessed by immediate recall of the story, was not affected by the kind of question asked since the respective percentages of propositions recalled by the Why and Who/Whom groups were 38 and 39. On this measure, the kind of question asked did not aid comprehension, i.e., the construction of a better memory representation. (Perhaps delayed recall would have been more sensitive to the quality of the representation.)

However, the why-questions seemed to have assessed the children's ability to construct a causal-chain representation better than the who/whom-questions. First, the correlation between accuracy on the why-questions and recall of the story was significant and higher than that for the who/whom-questions. The respective correlations were .77 ($p < .01$) and .40 ($p > .05$). However, since the level of performance on probe questions for the who/whom group (86%) was higher than that on the why questions (63%), the differences

between the correlations could have been a result of restriction of range rather than question effects.

Another analysis, however, suggested that the why-questions assessed individual differences in comprehension better than the who/whom-questions, and supported the assumption that understanding the concepts within a sentence precedes understanding of relations between sentences. Wimmer compared those 4 year old children who answered all questions correctly on their ability to recall the story. While the number of subjects was small, those children (n = 4) who answered all the why-questions recalled 80% of the story propositions, and those (n = 8) who answered all of the who/whom-questions recalled 46%. Further, age differences in recall were nearly eliminated when the 4 and 8 year old children were matched on answering why questions; here the respective percentages (and numbers) were 80% (n = 4) and 93% (n = 17).

Thus, there is some indication that children understand individual sentences before they connect them inferentially, and that understanding of the logical relations between sentences leads to better retention of a narrative. The question as to whether questions promote comprehension and which questions one should use remains unanswered by the two studies discussed here.

One goal of the above presentation has been to provide a framework in which to assess reading or listening comprehension via questions. The types of questions asked are systematically related to the types of relations that exist between states or actions in a narrative. The advantage of the causal chain approach is that it indicates the kind of processing required by

the reader in understanding concepts and relations between concepts in stories. Since teachers try nearly exclusively to use questions as their main means to assess comprehension (Durkin, 1977), a framework for systematic question asking which either promotes or assesses comprehension should prove to be a useful aid. Basic research on the value of systematic and theory-based questioning should also evaluate the usefulness of such procedures.

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Table 1

The Farmer and the Donkey Story

(From Mandler & Johnson, 1977)

1. There was once an old farmer
2. who owned a very stubborn donkey.
3. One evening the farmer was trying to put his donkey into its shed.
4. First, the farmer pulled the donkey,
5. but the donkey wouldn't move.
6. Then the farmer pushed the donkey,
7. but still the donkey wouldn't move.
8. Finally, the farmer asked his dog
9. to bark loudly at the donkey
10. and thereby frighten him into the shed.
11. But the dog refused.
12. So then, the farmer asked his cat
13. to scratch the dog
14. so the dog would bark loudly
15. and thereby frighten the donkey into the shed.
16. But the cat replied,
17. "I would gladly scratch the dog
18. if only you would get me some milk."
19. So the farmer went to his cow
20. and asked for some milk
21. to give to the cat.
22. But the cow replied,
23. "I would gladly give you some milk
24. if only you would give me some hay."
25. Thus, the farmer went to the haystack
26. and got some hay.
27. As soon as he gave the hay to the cow,
28. the cow gave the farmer some milk.
29. Then the farmer went to the cat
30. and gave the milk to the cat.
31. As soon as the cat got the milk,
32. it began to scratch the dog.
33. As soon as the cat scratched the dog,
34. the dog began to bark loudly.
35. The barking so frightened the donkey
36. that it jumped immediately into its shed.

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